

Institution: Newcastle University
Unit of Assessment: UoA 4
<p>a. Context</p> <p>As an academic unit with close synergies between basic, applied and clinical science, we target our impact activity at a diverse group of users and beneficiaries. These include: patients, clinicians, and other healthcare organisations who benefit from our research-led improvements in treatment and diagnosis; UK-based and international industries, especially pharmaceutical and high-tech companies; voluntary organisations, especially advocates for specific patient groups; animals, whose welfare in laboratory, industrial and natural settings we aim to improve; the government, via our involvement in health guidelines and policy setting; forensic and law enforcement practitioners, via our research into human behaviour; and broad sectors of the public, from schoolchildren to the elderly, who take part in our public engagement and out-reach programmes, and whom we involve in setting our research agendas to meet their needs. Our deliberate practice of involving potential beneficiaries in our research reflects the University's commitment to 'excellence with a purpose'. The range of impact types is correspondingly diverse, with our main focus on impacts in health and welfare, for both humans and animals, and especially on health in ageing; public policy and practice, especially on developing guidelines for diagnosis and treatment; commerce and the economy, via income generation through spin-out companies and improved cost-effectiveness of clinical treatments; and society and culture, where we aim to educate, engage, and inform debate, including on the ethics of animal research and the de-marginalisation of mental illness.</p> <p>The organisation of Research Institutes in Newcastle around core topics (including in the context of this UoA neuroscience and ageing), rather than traditional disciplines, has driven integrative collaborations between clinical and basic scientists. We are, therefore, able to translate research findings into immediate and long-term patient benefit, focussing especially on age-related chronic neurological and neurovascular diseases. The therapeutic interventions we have developed reflect the range of our systems neuroscience research tools and inter-disciplinary collaborations, and include: pharmacological agents (e.g. anti-depressants; Ferrier, McAllister-Williams; and drugs for dementia; McKeith); assistive devices (e.g. wearable electronics for motor rehabilitation following stroke; Baker, Jackson); and tele-rehabilitation (Eyre). Our basic research into human and animal behaviour and cognition impacts on animal welfare as well as human health, for example through the development of quantitative methods for assessing animal emotion and pain (Flecknell, Bateson). The success of our approach to promoting the importance of impact was recognised by our prize in the BBSRC 2011 "Excellence with Impact" national competition for the <i>Greatest Delivery of Impact</i>.</p>
<p>b. Approach to impact</p> <p>The importance and value of impact are embedded in our culture and working structures. Both at the unit level and at Faculty and University levels, we have fostered a culture which encourages, supports, facilitates and rewards impactful activities, including: the core research that ultimately generates impact by benefit to end-users; our well-established working relationships with individuals, companies and other organisations, including our NHS partners; and targeted engagement events that involve wide-ranging sectors of the public.</p> <p>Our research into neurological and psychiatric disease mechanisms, diagnosis and treatment aims to bring long-term benefits to society through improving health. Of the investigators returned in UoA4, 20 are clinical academics who directly engage with patients on a daily basis. Our approach involves engaging patients at every stage of the research process from identifying key research questions to protocol development and study implementation, and educating and involving the wider public in the scientific debate. We frequently interact with local and national disease-focussed groups, with whom we have long-standing relationships (e.g. Parkinson's UK, Lewy Body Society) and the patient and public involvement (PPI) systems embedded within the NIHR Research Networks (McKeith, Ford, Burn, Rodgers, Ferrier). An example of our combined approach to PPI comes from our NIHR Biomedical Research Unit (BRU) in Dementia with Lewy Body (DLB), whose 24-strong advisory group grew from consultations between the BRU PPI Lead and members of the North-East Dementia Alliance and VOICENorth, an inclusive regional group that involves the public in our Changing Age research initiative. Impacts have included changes to BRU study design and the formulation of new research questions. <i>Limbs Alive</i>, a University spin-out, is a flagship example of a research-led clinical innovation with measureable impact for service</p>

delivery: action video gaming-based rehabilitation programmes for stroke and cerebral palsy that allow remote data collection to monitor recovery and patient benefit (**Eyre**). **Economic** impact will result from reduced need for clinic visits and increased patient independence. Developed through collaboration between patients, the NHS and gaming companies supported by the Faculty's Enterprise Office and part-funded by the Wellcome Trust-DoH Health Innovation Challenge Fund (HICF), *Limbs Alive* was recognised by the 2011 Medical Futures Award for 'Best NHS Innovation'.

The substantial costs of converting scientific discovery to evaluated and implemented treatment mean that collaboration with industrial partners is critical for achieving impact in **commerce and the economy**. In the areas of drug development and diagnostic advances, we have developed collaborations with GE and Avid on functional imaging studies to improve diagnostic accuracy of DLB (**McKeith**), and with GSK and McLaren to develop more valid means of monitoring the effects of drug interventions on daily activity in people with neurodegenerative diseases (**Rochester**). Our work on novel pharmacological targets for treating schizophrenia undertaken jointly with Autifony Therapeutics is funded by the Technology Strategy Board (**Cunningham; LeBeau**). Additionally, companies directly invest in our research to guide their development of new products. For example, BSKyB harnessed our expertise in stereo vision to inform their development of 3D television (**Read**). These industrial partnerships, although often instigated by the researchers' public profiles, are facilitated and supported by the University Research and Enterprise Service, the Faculty Research Funding Development Managers, and the Institute Research Grants Officers.

To maximise our impact on **public policy and practice** we have cultivated relationships with professional and service organisations, including the regional police, the Home Office and Ministry of Justice (see **Flecknell** and **Grubin** case studies). For example, Northumbria police both helped develop, and now use, our colour vision diagnostic service (**Hurlbert; Jordan**). Following wide-spread media coverage of our research demonstrating that the simple image of eyes can induce honest behaviour (**Roberts; Bateson; Nettle**), police forces across the country (e.g. British Transport Police) have consulted us in developing crime prevention tactics based on such cues, and have collaborated in quantifying the impact in terms of crime reduction.

In addition to interacting with special interest groups such as patient organisations, we impact on **society and culture** through our research participation schemes, our varied public dissemination events, links with local cultural centres and partnerships with schools. Central to the success of this impact is the recognition and reward we build into the annual Performance and Development Review (PDR) process for academic staff who undertake these activities. Each year, for example, we run public engagement events in Brain Awareness Week, ranging from multi-disciplinary public symposia on mind-altering plants (2009) to the neuroscience of music (2011; with the Sage Gateshead) and 3D film (2012; with Tyneside Cinema), attracting 200-1000 individuals to each event. Our staff give public lectures and advise on exhibits at the Centre for Life. For the British Science Festival 2013, 24 of our staff and PhD students contributed 13 major public events, engaging around 2000 individuals. We sustain long-term collaborations with artists, both regionally and nationally, and since 2008, have co-produced five art exhibitions at venues including the Customs House, South Shields (2008) and the Great North Museum (2011). *Reassembling the Self* (Hatton Gallery; 2012), an exhibition of portraits and self-portraits of schizophrenia curated by our artist-in-residence Susan Aldworth, together with its wide-ranging accompanying events, enhanced understanding of mental illness for the 450+ members of the public attending. Through these and other engagement events, and via our active web presence, we have also recruited more than 1750 individuals to our database of basic research study participants.

An important local audience for our engagement activities are schools. We actively build relationships with schools in order to extend our impact to young people, and do so through delivering workshops and lectures (e.g. an event involving 8 regional schools exploring the development of dementia-friendly communities in the North East; and the 2009 public Holmes Lectures for 10-15 year olds on *My Brain and I*), engaging schoolchildren as participants in research (e.g. developing an auditory task for early identification of dyslexia; **Griffiths**) and assisting schools in science projects (e.g. *Is the Red I see the Red You see?*, a project at St Thomas More RC Academy, now in the finals of the 2013 National Science and Engineering Competition; Jordan). We have established an Institute Ambassadors programme for our post-graduates, investing in their outreach skills training; the Ambassadors recently ran a workshop on brain science for 220 year 9 pupils at Framwellgate School. We are active members of

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Understanding Animal Research and regularly talk at schools about the use of animals in research. Through these and other activities, we have reached well over 100 local schools. Vital to achieving our impact, especially on **society and culture**, is our full time External Liaison Coordinator (ELC) who supports staff in public engagement activities. Our ELC also works closely with the Faculty Press Officer to ensure timely impact to a wide audience; such as recent coverage on “bees buzz from caffeine” (**Wright**) and “wrinkly fingers” (**Smulders**). Our researchers have advised on and featured in numerous national and international radio and television productions, including “Do You See What I See?” BBC Horizon, 2011; “Technicolour” BBC Radio 4, 2013.

c. Strategy and plans

Through our strategic focus on applied and translational neuroscience, our culture that prioritises and promotes impactful activities, and our strong public, patient and commercial relationships, we will continue to generate and exploit further opportunities for impact. We will maximise impact by: increasing individual staff impact contributions; capitalising on our effective operational and support structures, both to deliver impacts from our portfolio of on-going projects and clinical trials and to identify previously unexploited impact domains; and creating even greater proximities between research and both the clinic and industry. In addition, specific plans include further expanding our patient involvement and public engagement activities, improving communication of our scientific discoveries for increased influence on policy, and streamlining commercialisation.

Our strategy to **increase individual staff impacts** includes: (1) recruiting individuals with high potential for translational research, exemplified by our recent appointment of **White**, Chair in Interventional and Diagnostic Neuroradiology, who has embarked on industrial collaborations to develop devices for treating cerebrovascular disease; (2) managing workloads to prioritise impactful efforts, exemplified by our recent award of dedicated academic time to Clinical SL **Whittaker**, who plans to develop a multi-channel EMG electrode for muscle imaging (EPSRC; £583K); and (3) providing effective support and guidance to staff who do excellent research but who are inexperienced at turning discoveries into impact. Our specific goals include the successful delivery of impacts from these and other ongoing projects, including insect collision detection implementation in cars (**Rind**), design of a stereo vision test based on 3D mobile technology (**Read**) and the £10M Wellcome-EPSRC Innovative Engineering for Health CANDO programme to develop an implant for focal epilepsy through to a first-in-man trial (2013-20; lead PI **Ingram**).

To achieve these goals, we will exploit our **operational and support structures** that are geared to impact generation. For clinical translation, these include Newcastle Biomedicine, a joint oversight organisation between the Faculty and our lead NHS partner Trust (Newcastle upon Tyne Hospitals Foundation NHS Trust (NuTH)), which manages research strategy at the interface through a Joint Research Executive, and which optimises commercial activity through a Joint Business Executive. For clinical trials, our UKCRC-registered Clinical Trials Unit supports the development, delivery and evaluation of new interventions. NuTH is currently top ranked in the top 5 Trusts in the UK for accrual into trials, due in large part to the NIHR networks linked to our UoA, which currently hold over £12.5M of funding for active clinical trials. We aim to successfully deliver current trials including, for example, two NIHR Health Technology Assessment (HTA)-funded programmes, evaluating an extended rehabilitation service for stroke patients (2012-2017; **Rodgers**) and a multi-centre randomised trial of donepezil in early dementia associated with Parkinson’s disease (2010-2015; **Burn**).

The Research Funding Development Managers and Project Managers in our Joint Research Office (JRO) will help us build on our experience with applied funding calls (e.g. HICF) for developing new ideas with potential clinical impact, and will particularly assist staff who are new to impact delivery. For commercial developments, our Enterprise Team includes Business Development Managers who support all aspects of business opportunities, including IP, research contracts for services, Knowledge Transfer Partnerships and the route to market for translational research projects.

In addition to these organisational facilities, we are creating **physical proximities between research and clinic**, e.g. via the Clinical Ageing Research Unit and our NIHR-funded Clinics for Research and Service in Themed Assessment (CRESTAs), a novel setting for innovation in clinical service development and delivery which is fully adapted to the needs of older patients, and the Wellcome Trust funded Centre for Translational Systems Neuroscience (opened in autumn 2013), which combines essential infrastructure for new experimental approaches with patient testing facilities to achieve ultimate impact on motor and sensory system disorders, schizophrenia and affective illness. The Centre will also support a new clinical research hub in aphasia (**Griffiths**) and

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new PPIs in epilepsy and developmental disorders. To strengthen links between **research and industry** we are providing incubation space for start-up companies, most directly in the Newcastle Biomedical Research Building where one floor accommodates six companies with a focus on ageing. Future impact will result from deployment of this new infrastructure, and developing our skills in commercialisation, both via the Enterprise team and through encouraging staff to participate in our programme on entrepreneurship developed with the Newcastle University Business School.

d. Relationship to case studies

Our routes to impact on **health and welfare** include influencing clinical policy at national and international levels, as well as industrial collaborations and commercial ventures. These dual routes are exemplified by the case of **McKeith**, who led the development of new diagnostic criteria to distinguish between DLB and Alzheimer's disease. These criteria have now been incorporated into national and international guidelines to aid correct treatment and appropriate management. The work has also resulted in a new diagnostic technique, the DaTSCAN from GE Healthcare, which is approved by the US Food and Drug Administration and the European Medicines Agency, and has been used in diagnosis of 200,000 people worldwide. A distinct route to commercialisation is illustrated by the case of **Young**, who developed a new computational drug discovery process based on analysis of the whole network of proteins involved in a particular disease. The University, via its Enterprise Office, backed the formation in 2007 of a spin-out company to implement the process which within 6 years became the eighth largest company in the biotechnology/pharmaceutical sector listed on the AIM of the London Stock Exchange, with a market capitalisation of over £90 million. Benefit to the economy through income generation and employment synergises with ultimate benefit to health. This case also highlights our culture of supporting third-strand impact as Young was seconded from his academic post to develop this business venture. The case of **McKeith/Burn** arises from Newcastle's long history of dementia research and our organisational structures that support translation and close working with the NHS. McKeith/Burn proved that a class of drugs, cholinesterase inhibitors, may be more beneficial in patients with DLB and Parkinson's disease dementia. Their clinical trials work, essential for realising impact, was built on basic science discoveries on the origins of the diseases, with the crucial collaboration facilitated by the Institute for Ageing and Health, Newcastle's first integrated translational research institute. Our involvement with influential national and international consortia has since converted the research findings into established guidelines for diagnosis and therapy. In **Slater/Lochmuller's** case, improvements in disease diagnosis and prognosis have arisen from our long-term relationships with particular patient cohorts, combined with the dissemination of basic scientific discoveries, close collaboration with international colleagues, and our leadership of international disease-focussed groups (the European Neuromuscular Centre). This case revealed mutations in congenital myasthenic syndromes that do not impact on the ACh receptor, thus explaining why patients with limb-girdle myasthenia do not respond to treatments given for other forms of congenital myasthenia. Crucially, these patients may now be diagnosed accurately via genetic testing at four international centres (680 patients recently included in mutation screening) and treated effectively with ephedrine and salbutamol. **Flecknell's** case demonstrates how combining our commitment to high ethical standards of animal welfare and our fundamental research on animal behaviour has led to international impact. Recognising the relative under-use of analgesics in animal research, Flecknell led work to develop an objective way to establish effective doses of analgesics using behaviour-based pain scoring. This led to changes in policy statements, institutional policies and research worker practices. Appropriately monitored animal models are essential to discovery science and the development of new drug treatments. Thus, we have generated impact on different time scales: immediate benefit to animal welfare, with long-term benefit to human health. Our impact on **public policy and practice** is exemplified by the case of **Grubin** who led trials for the Home Office and Ministry of Justice to test whether polygraphy could aid case officers manage high-risk sex offenders released on licence. Early trials, in which assessment of offenders was voluntary, yielded encouraging results and led to the passage of enabling legislation for a study of mandatory assessment which started in 2009. That trial conclusively demonstrated that polygraph testing helped case managers evaluate the risk posed by offenders and decide how best to protect the public. A policy of mandatory polygraph assessment of all high-risk sex offenders on parole in England and Wales was approved by ministers in 2012.